

## ISA Report

### Project Title- Integrated agricultural systems to promote soil health and environmental resilience

### LAIYERS (Land mAnagement for improved Yields, Environmental Resilience, and Sustainability)

### Research Site and Experimental Treatments



**Figure 1. Updated schematic illustrating the plot layout and features.** The experimental treatments (System 1-9) were randomly assigned in a block design determined by site soil characteristics. Treatments include manure or chemical fertilizer (UAN) application before corn, with early winter or spring poultry manure at 150 lbs N/acre; spring UAN at 150 lbs N/acre; balance poultry manure with UAN with an early winter poultry manure at 150 lbs N/acre followed by UAN at 150 lbs N/acre; and split UAN with 100 lbs N/acre spring applied and 50 lbs N/acre as sidedress.

## **Year 1 Field Activities and Sample collection**

### **Soybeans were planted late in the season.**

The Research Farm was able to keep our original year 1 plan of planting soybeans, although soybeans were planted late in the season after the tile installation was complete. The soybeans were planted on June 30th, and were harvested on October 19th. The late season planting and dry weather conditions resulted in very low average yields of 19 bushels per acre compared to the county average of 63 bushels per acre in 2021.

### **Volunteer oat coverage was recorded.**

Before installation of the center plot tile lines in the spring of 2021, the plots at field 40 were planted to oats so there would be vegetative coverage until the tiles were installed. After installation in mid-June, soybeans were planted. The soybeans were harvested on October 19th before soil sample collection from October 20<sup>th</sup>-22<sup>nd</sup>. There was considerable volunteer oat coverage in the plots noticeable after the soybeans were harvested. The vegetation coverage app, Canopeo, was used to document the volunteer oats coverage in each plot on November 4<sup>th</sup> and 5<sup>th</sup>. The average coverage per plot ranged from 6% to 16%, with an overall field average of 11%. The oats did not cover the plots evenly, but were stripped throughout the plots (fig. 2). The planned cover crop, winter rye, was planted on November 5th.



**Figure 2. Photograph of volunteer oat coverage in a field 40 plot on Nov. 20, 2021.** There was considerable oat coverage in the field 40 plots after soybean harvest, with strips of heavier coverage within the plots.

**Plot level soil sampling provides detailed baseline condition records.**

### **Soil Sample Collection**

Plot level topsoil (0-12") and Uhland cores (0-6") were collected October 20-22 of 2021, and have been processed and analyzed similarly to the fall 2020 samples for detailed evaluation of soil health characteristics and nutrients (fig. 3). Additional soil analysis at the site includes a field level analysis of extreme deep core samples (8-9' depth, divided into 1' increments) (fig. 4).



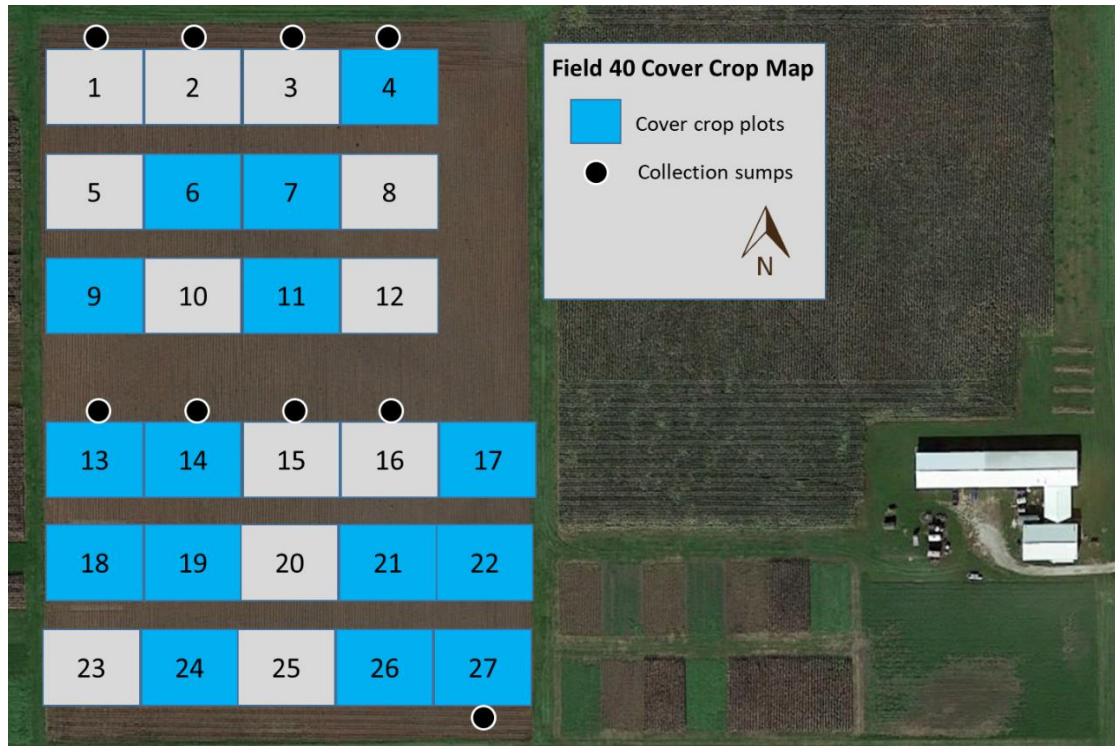
**Figure 3. The WQRL research team collected Uhland cores and topsoil samples in the fall of 2021 for plot level nutrient and soil health analysis.** Three Uhland core samples were collected per plot, then processed and composited in the lab for analysis. The topsoil samples were divided into 0-6" and 6-12" increments in the field, with 4-6 samples collected at each plot depending of the diameter of the probe used for collection to ensure an adequate volume of sample for analysis.



**Figure 4. Soil characterization samples were collected to a depth of 9' at four plots.** Our research group has partnered with Dr. Sotirios Archontoulis' (Integrated Cropping Systems Lab, Iowa State University) research group for additional analysis at the site. Extreme deep core samples were collected to a depth of 8-9' for analysis of various soil characteristics, which will provide a detailed soil profile for the field.

**Cereal rye was planted at the designated treatment plots.**

Due to wet conditions in the field and the late soybean harvest, winter cereal rye was planted at the designated plots after soybean harvest on November 5<sup>th</sup> (fig. 5). We did not see emergence of the cereal rye in the fall. There has been some germination observed in early spring. The spring cereal rye coverage and biomass will be evaluated in late April, 2022.



**Figure 5. Updated research site cover crop map. Cover crops will be planted each year at the designated plots.**

**The early winter poultry manure treatments were applied in 2021.**

Poultry manure, which was donated by Farm Nutrients, was delivered and stockpiled for fall 2021 (early winter treatment) and spring 2022 (fig. 6).

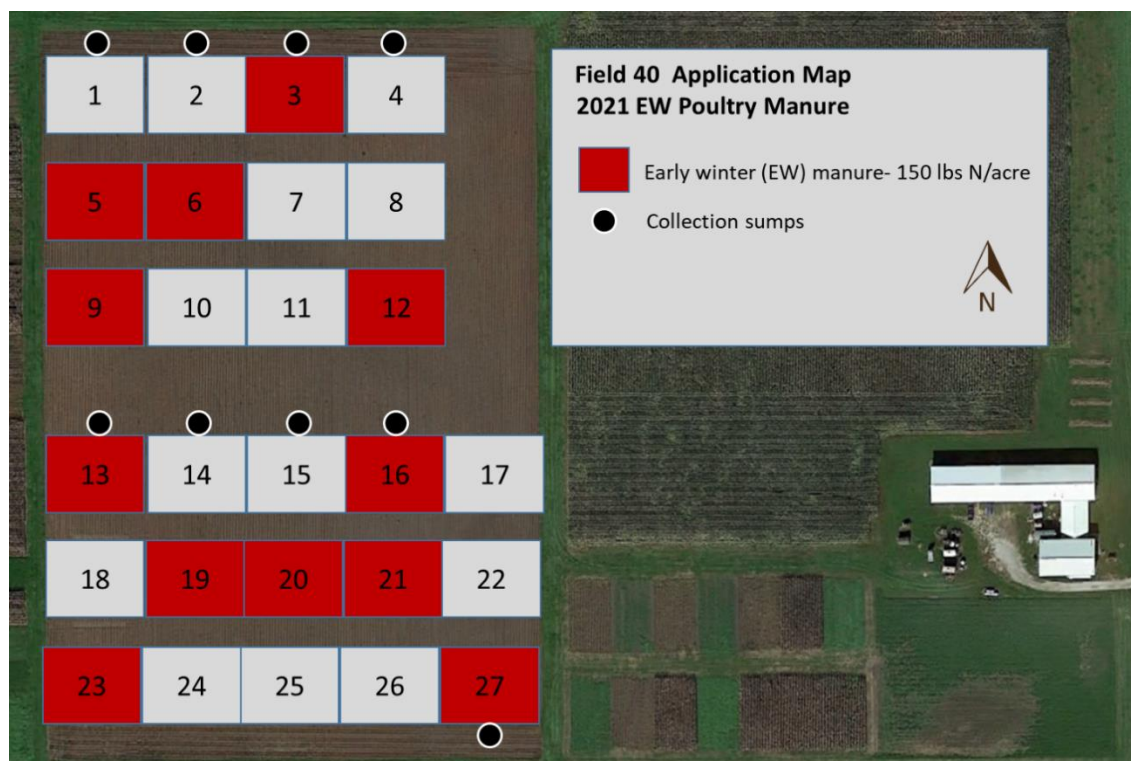


**Figure 6. Poultry manure delivery for 2021 early winter and 2022 spring manure applications.**

The bulk manure was analyzed before application to estimate application rates. At the time of application, plot level samples will be collected from the manure wagon for analysis to calculate the achieved nutrient application rate at each plot.

The spring year 2 (2022) field activities will include UAN and poultry manure application at the designated plots (figs. 7 & 8). All plots will then be planted to corn in 2022.

Drainage samples and flow volume measurements will be collected at all plots throughout the drainage season while the plots are actively draining. These samples will be collected as grab samples with manual flow rate measurements at least once per week.



**Figure 7. Updated 2021 early winter (ew) manure application map. Manure was applied (12/02/21) to the plots designated in red.**

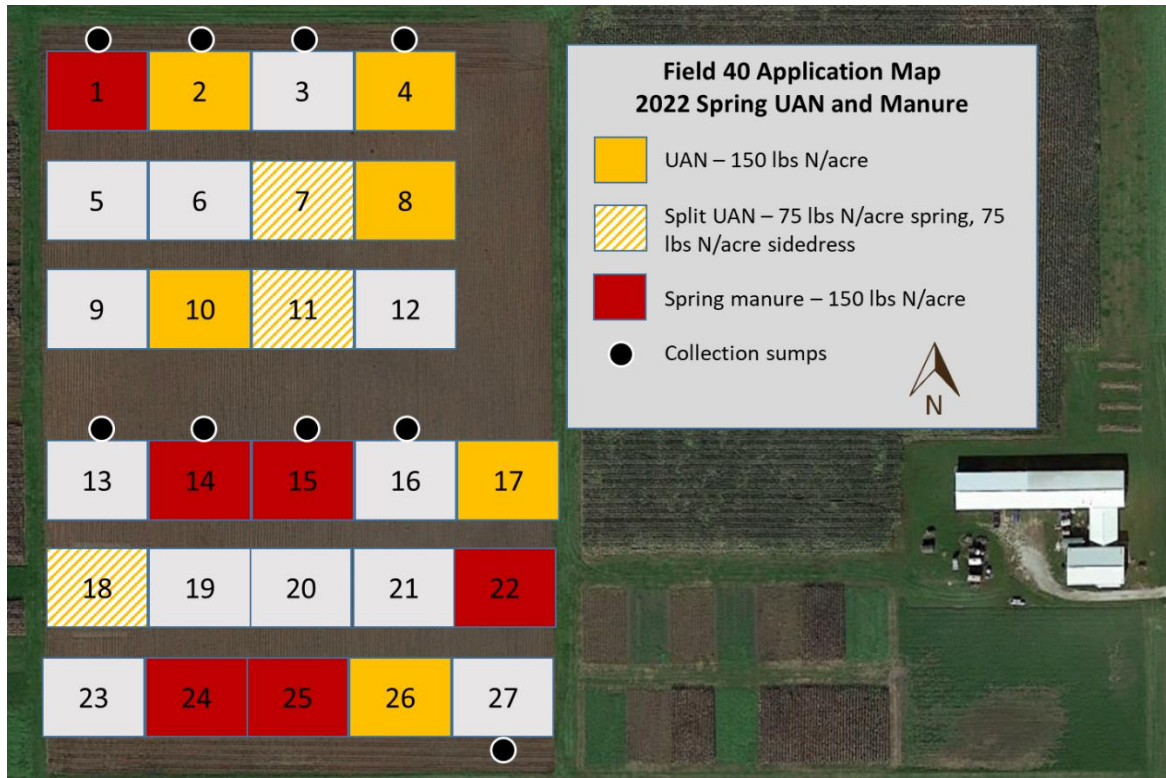


Figure 8. Planned spring 2022 manure and UAN treatments. The plots designated for UAN and split UAN treatments had P&K applied at 100 lbs/acre in the fall of 2021.

Preliminary plot level analysis shows minimal characteristic differences.

	Total Available N (NO <sub>3</sub> +NH <sub>4</sub> )	Soil Phosphorus (M3-P)	OM(%)	Soil pH	CEC
System 1	29	39	4	7	31
System 2	27	26	4	6	30
System 3	31	35	3	5	23
System 4	30	35	3	6	27
System 5	29	39	3	6	30
System 6	34	58	4	6	29
System 7	27	44	4	6	34
System 8	28	40	4	6	24
System 9	26	31	3	6	26
Average	29	39	4	6	28

**Table 1. Select analyses from the fall 2011 topsoil (0-6").** The fall 2021 soil samples reflect conditions before the experimental treatments were initiated at the plots. The most notable differences measured show increased phosphorus levels at some plots. Organic matter (OM) averages 4%, and soil pH ranges between 5 and 7.

### **Progress Toward Project Metrics**

Our group continues to make good progress toward KPI #1. Soil samples were collected in the fall of 2021 at each plot to provide detailed plot level baseline conditions. These samples have been processed for bulk density and texture analysis, aggregate size distribution, soil nutrient levels, and particulate organic matter nitrogen and phosphorus. Additional samples were collected on March 20<sup>th</sup> and 21<sup>st</sup> for weed seed bank analysis to establish the baseline densities. We are seeing signs of good drainage flow at the site, and will begin drainage sample collection in April.

KPI #2- improved understanding of manure integrated cropping systems and their impact on crop yield and water quality will be achieved through continued progress on KPI #1 and additional years of monitoring and data collection. The first comparative water quality samples from spring and fall manure application will be collected in year two (2022), which will reflect water quality impacts from the early winter 2021 spring manure application and the spring 2022 poultry manure application.